A portrait of AI adopters across countries

Firm characteristics, assets' complementarities and productivity

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AI has strong potential, but international evidence about its diffusion is limited

- Artificial intelligence (AI) is rapidly transforming the economic landscape
  - AI is often considered a **general-purpose technology** whose applications can improve the productivity of adopters

- Little empirical work has comprehensively analysed the patterns of AI diffusion across firms, especially at the **international level**

- This is crucial to better understand how to fully leverage the potential of the digital transformation and what are its implications for the economy

A novel distributed approach: *AI diffuse*

- ***AIM*: draw a portrait of AI adopters across countries**
  - Firm characteristics
  - Role of complementary assets (e.g., intangibles or digital infrastructure)
  - Links between AI use and productivity

- ***HOW*:** pioneering a **distributed microdata approach (*AI diffuse*)** based on a common statistical code
  - Run on firm-level **official surveys** in a decentralised manner

- ***COVERAGE***: **11 countries**
  - **Belgium, Denmark, France, Germany,** Ireland**, Israel, Italy, Japan, Korea, Portugal, Switzerland**

Key findings

- The use of AI is more widespread across **large** – and to some extent across **young** – firms and is prevalent in **ICT and Professional** services

- **Complementary assets** are key for AI use
  - ICT skills and training, firm-level digital capabilities, digital infrastructure

- AI users tend to be **more productive,** especially the largest ones, although **these premia do not seem to reflect the use of AI alone**

- **Complementary assets** appear to play a key role**,** with productivity advantages likely related, in most cases, to the **selection** of more digital and competitive firms into AI use

Existing evidence on AI use

References to the existing literature, based on different data sources

- Firm-level surveys
  - USA (Zolas et al., 2020; Acemoglu et al., 2022); DEU (Rammer et al., 2022; Czarnitzki et al., 2022); KOR (Cho et al., 2022)
- Online job postings
  - USA (Babina et al., 2020; Alekseeva et al., 2021; Acemoglu et al., 2022); FIN (Bäck et al., 2022); cross-country (Squicciarini and Nachtigall, 2021)
- IPRs
  - USA (Alderucci et al., 2020); FRA (Di Biaggio et al., 2022); cross-country (Damioli et al., 2021; Dernis et al., 2021; Baruffaldi et al., 2020); exposure to occupations (Felten et al., 2021; Webb, 2019)
- Other / multiple data sources
  - Import (Domini et al., 2021; 2022; Aghion et al., 2020); Online websites (Dernis et al., 2023); Combining sources (Calvino et al., 2022)

Wrapping up existing evidence

- Positive association between AI use and size
  - Fixed costs, scale advantages, data (Bessen et al., 2021)
- More ambiguous findings on the links between AI and productivity
  - Lack of relation can be due to J-curve dynamics (Brynjolfsson, Rock and Syverson, 2021)
  - ML as a prediction technology (Agrawal, Gans and Goldfarb, 2019)
  - Emerging literature on specific AI applications (Brynjolfsson et al., 2023; Noy and Zhang, 2023; Ziegler et al., 2022)

This work:

- Cross-country perspective using official representative data
- Exploring directly not only the characteristics of adopters but also the links with complementary assets
- Links between AI use and productivity

Data and methodology

Official firm-level surveys across countries

- Official data from NSOs in 11 countries
  - Belgium, Denmark, France, Germany, (Ireland), Israel, Italy, Japan, Korea, Portugal, Switzerland
- Information available on
  - Firm characteristics (sector, age, size, turnover, labour productivity)
  - Technology use (dummy variables – e.g., does your enterprise use any of the following AI technologies?)
  - Complementary assets (digital infrastructure, ICT skills / training, other digital technologies)
- Main features
  - Representative (of the 10+ firm population); weights available for most countries
  - Country-specific coverage (between 2017 and 2021)
  - Definitions can vary across countries (Eurostat harmonization)

A distributed microdata approach: *AI diffuse*

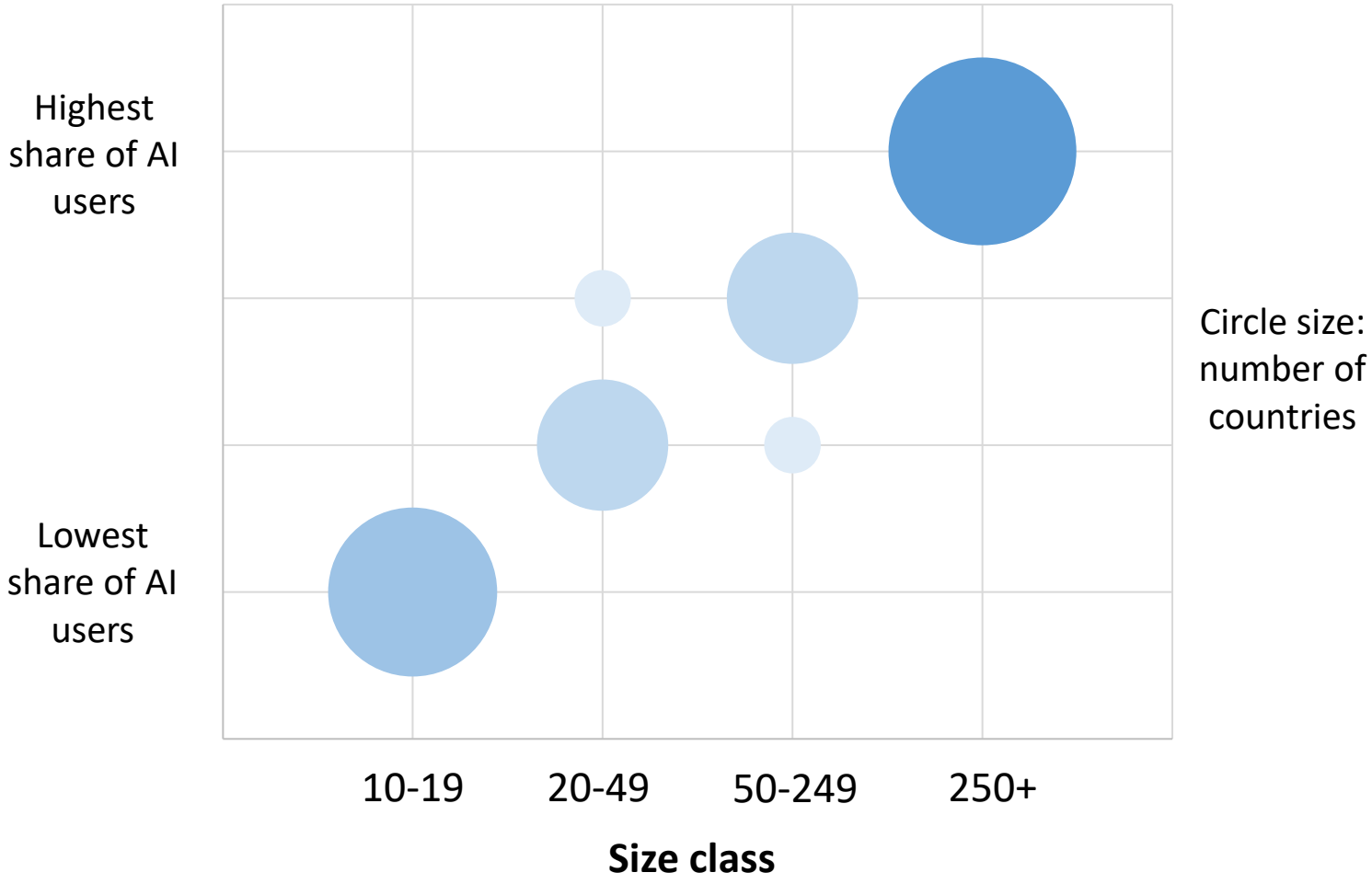
- Distributed microdata approach
  - Statistical code developed by the OECD and run by experts that have access to confidential data
  - Separate analysis for each country using a harmonised methodology
  - Consistency checks and metadata validation in collaboration with experts
  - Building upon the experience of other OECD distributed microdata projects (e.g., DynEmp, MultiProd, MicroBeRD)

- Main *AI diffuse* outputs
  - Summary statistics (shares of adoption, summary, co-occurrences)
  - Distributed regressions (adoption regressions, productivity regressions)

Firm characteristics and assets complementarity

AI is more widely used across large firms…

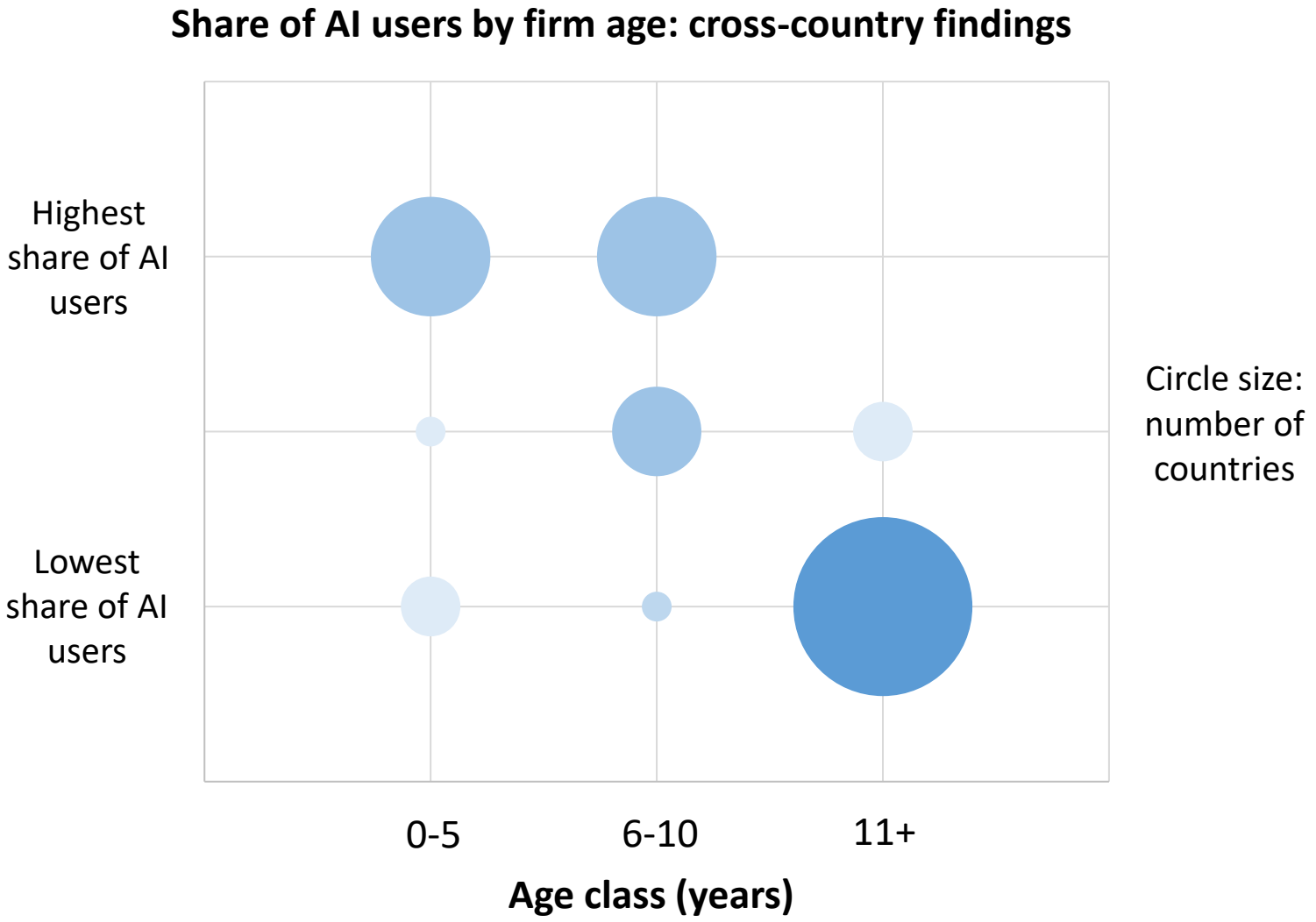
Share of AI users by firm size class: cross-country findings



Notes: based on 10 countries (Belgium, Denmark, France, Germany, Israel, Italy, Japan, Korea, Portugal, and Switzerland). The *y*-axis shows the ranking for shares of AI users. Circles' size is proportional to the number of countries for which the relation holds. For Korea, the size-class 10-19 is not available (not reported, the 20-49 class is assumed to be the second lowest).
Source: elaborations based on the OECD (*AI diffuse*) database (see the paper for full list of sources).

Country figures

...and to some extent across younger ones

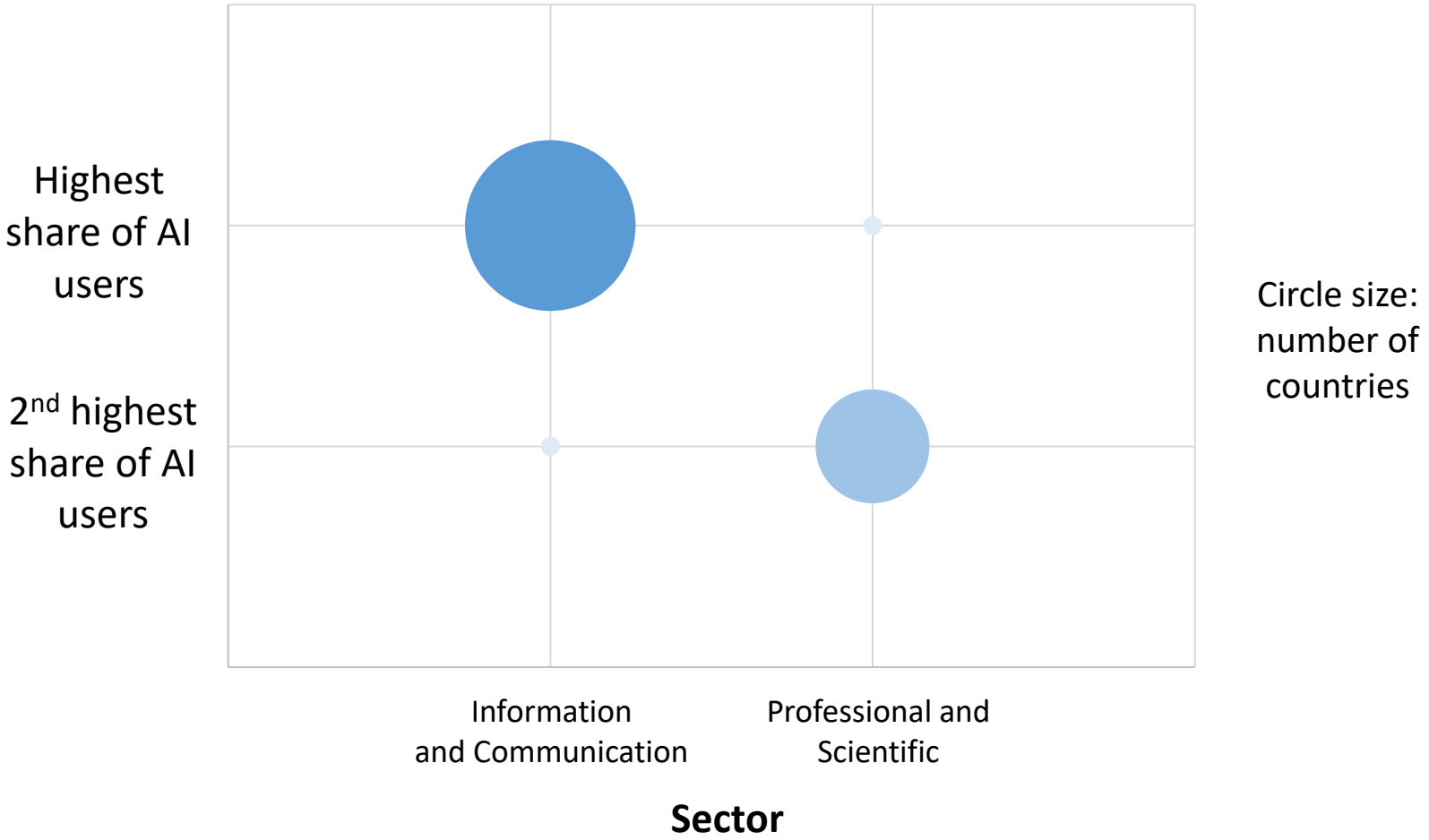


Notes: based on 8 countries (Belgium, Denmark, France, Israel, Japan, Korea, Portugal, and Switzerland). The *y*-axis shows the ranking for shares of AI users. Circles' size is proportional to the number of countries for which the relation holds. For Switzerland, the age-class 0-5 is not available (not reported, assumed to be 2nd in the ranking).
Source: elaborations based on the OECD (*AI diffuse*) database (see the paper for full list of sources).

Country figures

Shares of AI use are higher in ICT and in Professional and Scientific services

Share of AI users by firm broad sector: cross-country findings for ICT and Professional and Scientific Services

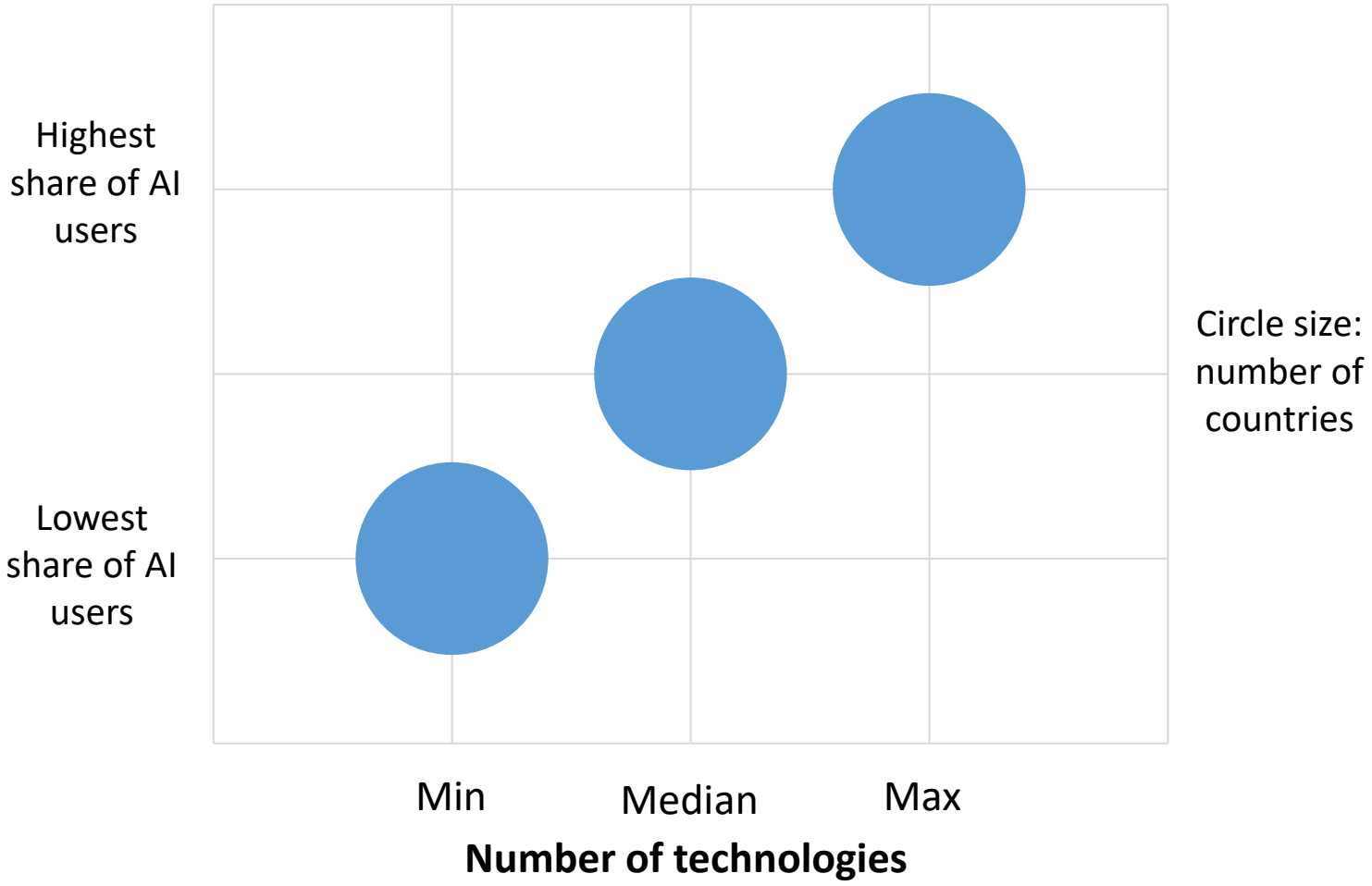


Notes: 10 countries in total (Belgium, Denmark, France, Germany, Israel, Italy, Japan, Korea, Portugal, and Switzerland). The *y*-axis shows the ranking for the two highest relative shares of AI adoption, by two sectors (ICT and Professional and Scientific). Circles identify the number of countries for which the relation holds. Accommodation and Food sector is the second highest share for Switzerland (not reported). Manufacturing & Utilities is the second highest share for Israel (not reported). Administrative and Real Estate is the second highest share for Portugal (not reported).
Source: elaborations based on the OECD (*AI diffuse*) database (see the paper for full list of sources).

Country figures

AI and other technologies

Share of AI users by number of technologies: cross-country findings



Notes: based on 9 countries (Belgium, Denmark, France, Israel, Italy, Japan, Korea, Portugal, and Switzerland). The *y*-axis shows the ranking for shares of AI users. Circles' size is proportional to the number of countries for which the relation holds.
Source: elaborations based on the OECD (*AI diffuse*) database (see the paper for full list of sources).

Country figures

Adoption regressions

- Previous slides: purely descriptive analysis

- Next: move to regression analysis to take into account the role of confounding factors & compositional effects

$$AI_{i,t} = a + b_1\, SizeClass_{i,t} + b_2\ AgeClass_{i,t} + FE_{i,t} + e_{i,t}$$

where *AI* is the AI use binary variable, *SizeClass* and *AgeClass* are fixed effects based on size and age classes, *FE* identifies sector and, upon availability, year fixed effects. Subscripts *i* identifies the firm and *t* the year.

Adoption regressions: main findings

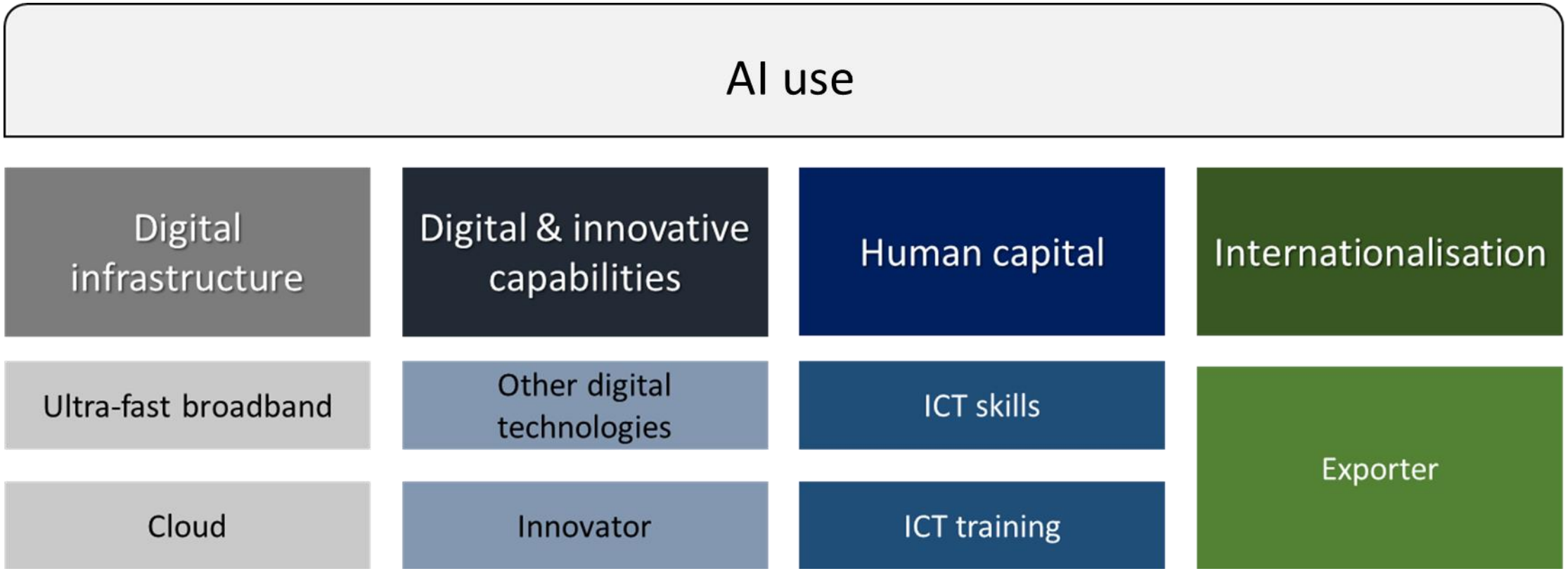
- Broadly confirm findings from descriptive analysis

1. Large firms are more likely to use AI
   - Likelihood to use AI generally increases with size class

2. Older firms, conditional on size and sector, tend to be less likely to adopt AI

Regression table

Focusing on the role of complementary assets

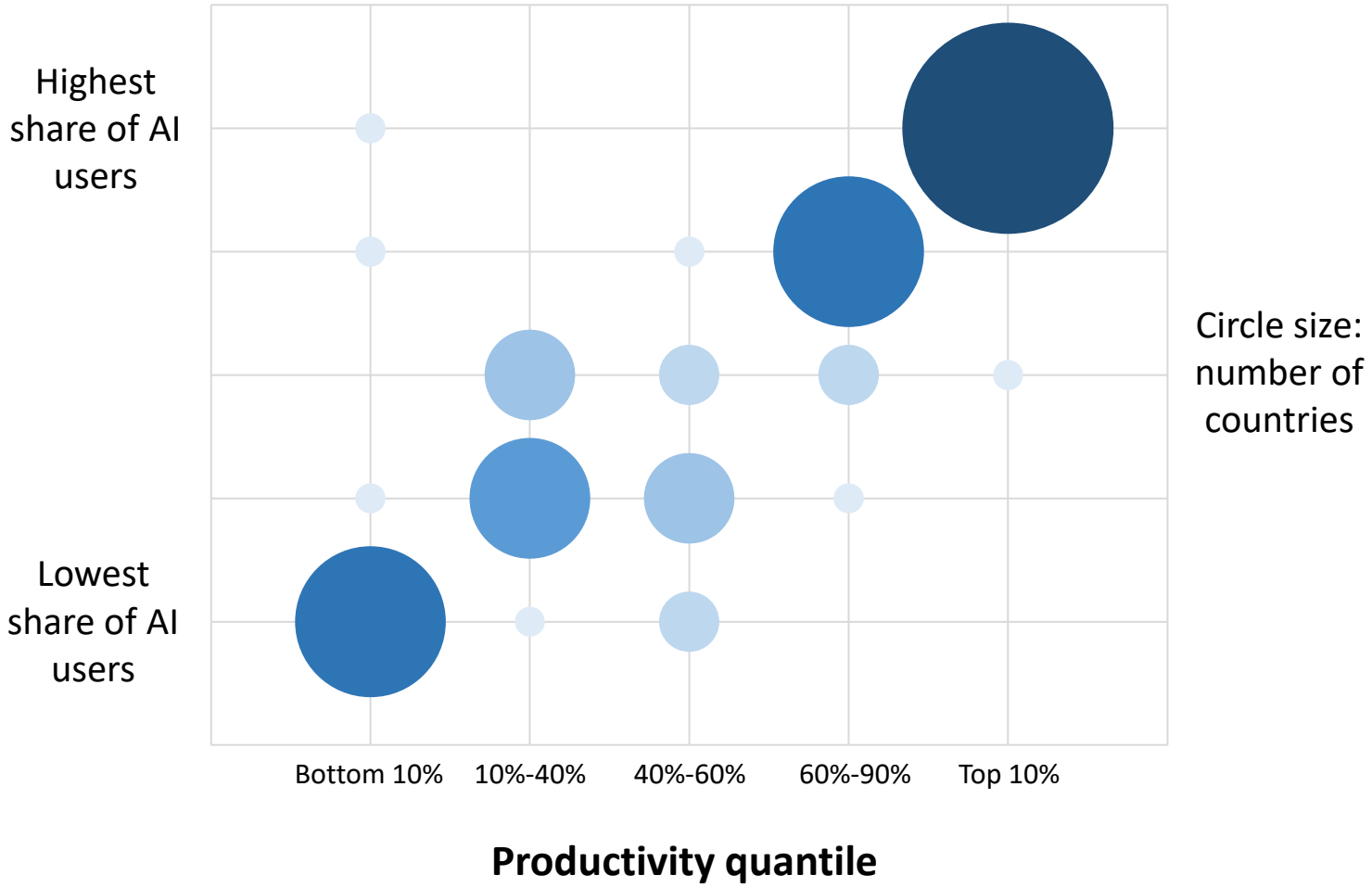


Regression table

AI use and productivity

Descriptive evidence

Share of AI users by productivity quantile: cross-country findings



Notes: based on 8 countries (Belgium, Denmark, France, Germany, Italy, Japan, Korea, and Switzerland). The *y*-axis shows the ranking for shares of AI users. Circles' size is proportional to the number of countries for which the relation holds.
Source: elaborations based on the OECD (*AI diffuse*) database (see the paper for full list of sources).

Country figures

Productivity regressions

- Next: move to regression analysis focusing on the links between AI use and productivity

$$Log(Productivity)_{i,t} = a + b_1 AI_{i,t} + b_2\, SizeClass_{i,t} + b_3\ AgeClass_{i,t} + FE_{i,t} + e_{i,t}$$

where *Log(Producivity)* is the logarithm of labour productivity, *AI* is the AI use binary variable, *SizeClass* and *AgeClass* are fixed effects based on size and age classes, *FE* identifies sector and, upon availability, year fixed effects. Subscripts *i* identifies the firm and *t* the year

AI users tend to be more productive…

AI use and labour productivity

		AI users
Country	Belgium	
	Denmark	
	France	
	Germany	
	Israel	
	Italy	
	Japan	
	Korea	
	Switzerland	

= Relation is positive and significant

- Regression results control for several confounding factors

Regression table

AI users tend to be more productive…

AI use and labour productivity **(with size class interactions)**

		AI users		AI users	AI users x Large size class (250+)
Country	Belgium	■		■	
	Denmark	■			■
	France	■		■	■
	Germany	■			
	Israel				■
	Italy	■			■
	Japan				■
	Korea	■			■
	Switzerland				

■ = Relation is positive and significant

- Regression results control for several confounding factors
- These productivity premia tend to originate from **large firms**

Regression table

…but premia do not reflect the use of AI alone

AI use and labour productivity

		AI users
Country	Belgium	
	Denmark	
	France	
	Germany	
	Israel	
	Italy	
	Japan	
	Korea	
	Switzerland	

= Relation is positive and significant

…but premia do not reflect the use of AI alone

AI use, complementary assets, and labour productivity

		AI users	Complementary assets
Country	Belgium		
	Denmark		
	France		
	Germany		
	Israel		
	Italy		
	Japan		
	Korea		
	Switzerland		

- **Complementary assets** appear to play a key role
  - Productivity premia significantly reduce when accounting for those
- Productivity advantages likely related to the **selection** of more digital and competitive firms into AI use
- Initial evidence of more direct effects of AI on productivity for **developers**

= **Relation is positive and significant**

= **Relation is positive and significant with lower magnitude** (with respect to the previous slide)

Regression table

Main takeaways and policy implications

Main takeaways

- The use of AI is more widespread across **large** – and to some extent across **young** – firms and is prevalent in **ICT and Professional** services

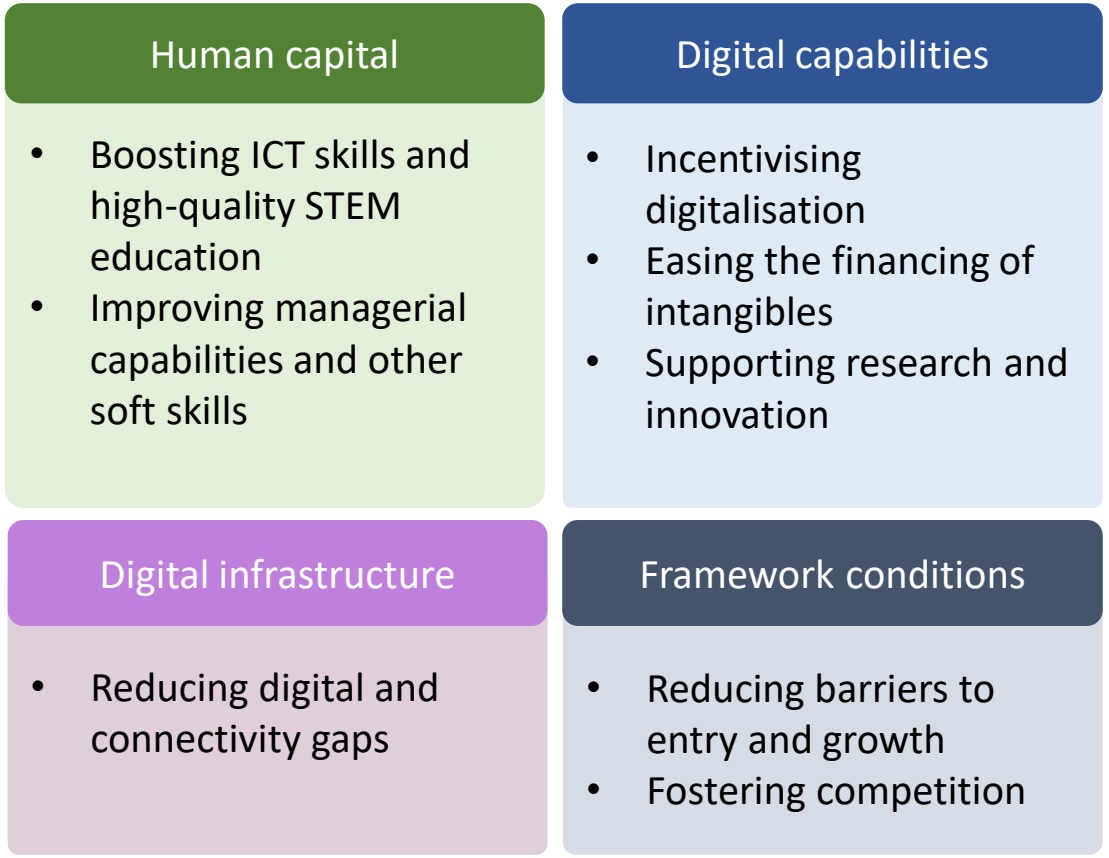
- **Complementary assets** are key for AI use
  - ICT skills and training, firm-level digital capabilities, digital infrastructure

- AI users tend to be **more productive,** especially the largest ones, although **these premia do not seem to reflect the use of AI alone**

- **Complementary assets** appear to play a key role**,** with productivity advantages likely related, in most cases, to the **selection** of more digital and competitive firms into AI use

Policy makers can play a key role to foster an inclusive digital transformation in the age of AI

- A role of AI strengthening the advantages of larger and more productive firms may imply widening **gaps between leading and other firms**
- A broad policy mix affecting incentives and capabilities may allow AI use and its returns to be **more widespread** across firms and sectors



Thank you

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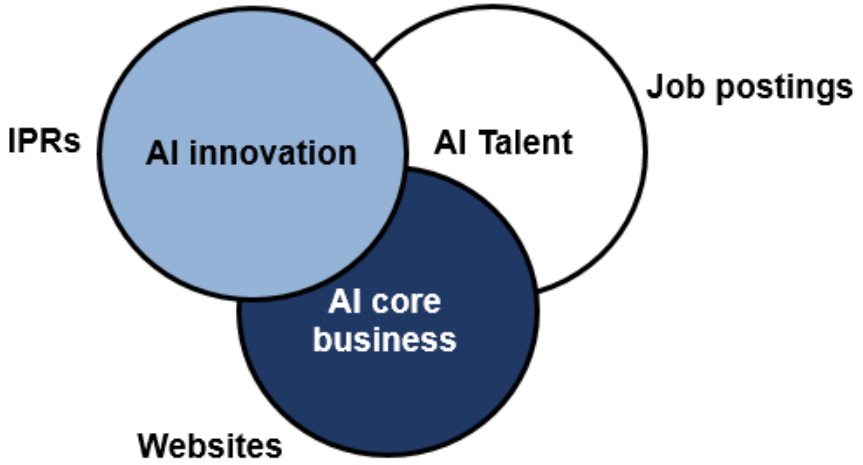
Other related work on AI diffusion

Based on joint work with Chiara Criscuolo, Hélène Dernis, Laurent Moussiegt, Cody Morris, Daisuke Nawa, Lea Samek, Mariagrazia Squicciarini

Identifying and characterising different types of AI adopters combining different data for the UK

- **Emsi Burning Glass** (EBG) – demand for AI skills in job postings (2012-20)
- **GlassAI** – AI keywords on companies' websites (2020)
- **Trademarks & Patents** (IPRs) – innovating in or embedding AI in goods and services (until 2018)
- **BvD Orbis** – company accounts (2019, latest available year with comprehensive coverage)

Information on AI activity



Notes: data sources (IPRs, Job postings and Websites) are reported outside of the Venn diagram, whereas group names of AI adopters (AI innovation, AI core business, AI talent) identified in the respective data source are reported inside the Venn diagram.
Sources: authors' elaboration based on Calvino et al. (2022)

Firms'/universities' websites and online job postings

- Evidence on AI-related online presence across countries (GlassAI)
  - Analysis of the characteristics and activities of **companies** and **universities** in Canada, Germany, United Kingdom and United States

Companies

- Young and small
- Operate in ICT
- Have an AI core business
- Provide customers' solutions

Universities

- Concentrated in and around large cities
- Similar AI activity intensity

Source: Dernis et al. (2023)

Additional Figures and Tables

Figure A.1 Share of AI users by size class

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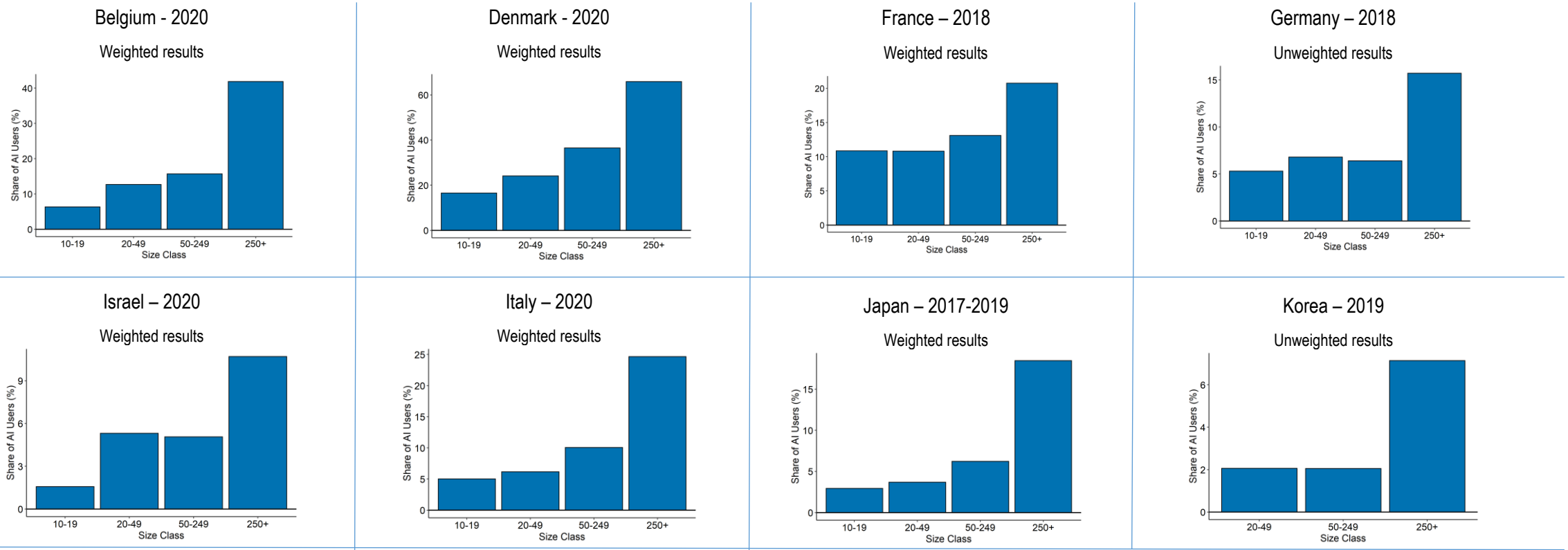

Notes: This figure reports the share of AI user by size class for Belgium, Denmark, France, Germany, Israel, Italy, Japan, Korea, Portugal, and Switzerland. Size classes encompass 4 categories: between 10 and 19 persons employed, between 20 and 49 persons employed, between 50 and 249 persons employed, and 250 or more persons employed. Figures for Belgium, Denmark, France, Israel, Italy, Japan, Portugal, and Switzerland are weighted. Figures for Germany and Korea are unweighted. In Korea the data for the smallest size class are unavailable due to confidentiality restrictions. Owing to methodological differences, figures may deviate from officially published national statistics.

Sources: Belgium - Survey on ICT and E-commerce in Enterprises; Denmark - ICT Use in Enterprises; France – Enquête sur les Technologies de l'information et de la communication et commerce électronique (TIC); Germany – Mannheim Innovation Panel; Israel - Survey on ICT uses and Cyber Defence in Businesses; Italy - Rilevazione sulle tecnologie dell'informazione e della comunicazione (ICT) nelle imprese; Japan - Japanese National Innovation Survey; Korea – Survey on Business Activities; Portugal - Inquérito à Utilização de Tecnologias da Informação e da Comunicação nas Empresas (IUTICE); Switzerland - KOF Enterprise Panel.

Figure A.2 Share of AI users by age class

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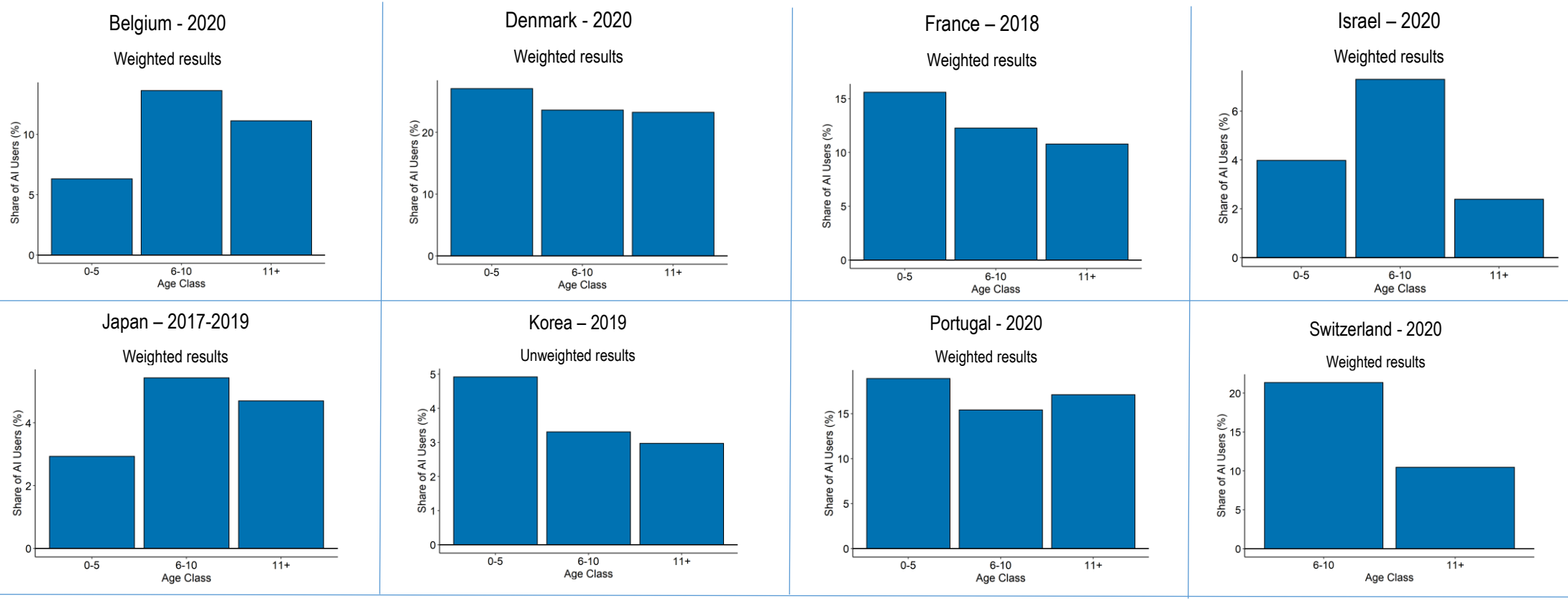

Notes: This figure reports the share of AI user by age class for Belgium, Denmark, France, Israel, Japan, Korea, Portugal, and Switzerland. Age classes encompass 3 categories: less than 6 years old, between 6 and 10 years old, and 11 or more years old. Figures for Belgium, Denmark, France, Israel, Japan, Portugal, and Switzerland are weighted. Figures for Korea are unweighted. In Switzerland the data for the youngest age class are unavailable due to confidentiality restrictions.

Sources: Denmark - ICT Use in Enterprises; France - Enquête sur les Technologies de l'information et de la communication et commerce électronique (TIC); Israel - Survey on ICT uses and Cyber Defence in Businesses; Japan - Japanese National Innovation Survey; Korea - Survey on Business Activities; Portugal - Inquérito à Utilização de Tecnologias da Informação e da Comunicação nas Empresas (IUTICE); Switzerland - KOF Enterprise Panel.

Figure A.3 Share of AI users by sector

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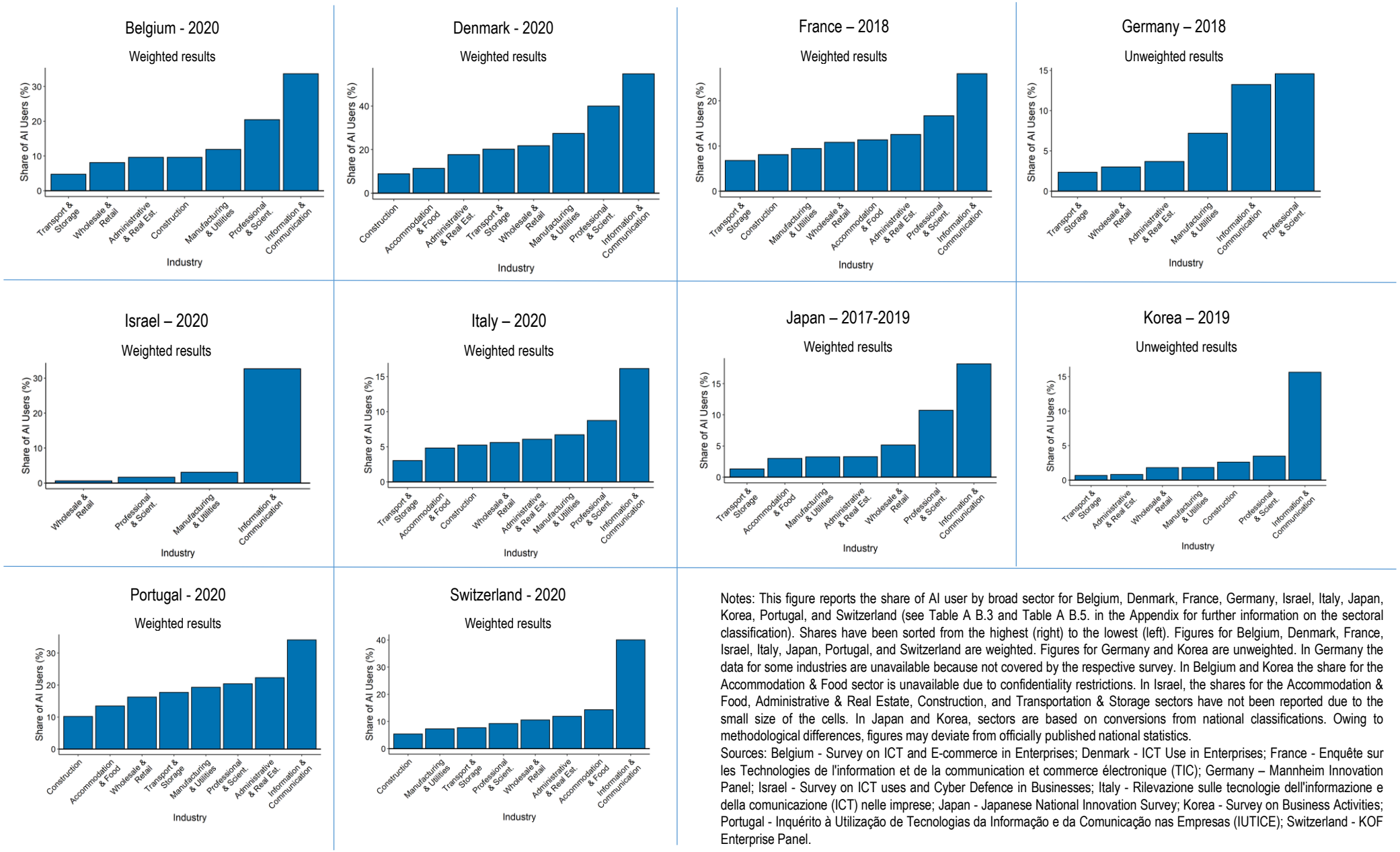

Notes: This figure reports the share of AI user by broad sector for Belgium, Denmark, France, Germany, Israel, Italy, Japan, Korea, Portugal, and Switzerland (see Table A B.3 and Table A B.5. in the Appendix for further information on the sectoral classification). Shares have been sorted from the highest (right) to the lowest (left). Figures for Belgium, Denmark, France, Israel, Italy, Japan, Portugal, and Switzerland are weighted. Figures for Germany and Korea are unweighted. In Germany the data for some industries are unavailable because not covered by the respective survey. In Belgium and Korea the share for the Accommodation & Food sector is unavailable due to confidentiality restrictions. In Israel, the shares for the Accommodation & Food, Administrative & Real Estate, Construction, and Transportation & Storage sectors have not been reported due to the small size of the cells. In Japan and Korea, sectors are based on conversions from national classifications. Owing to methodological differences, figures may deviate from officially published national statistics.

Sources: Belgium - Survey on ICT and E-commerce in Enterprises; Denmark - ICT Use in Enterprises; France - Enquête sur les Technologies de l'information et de la communication et commerce électronique (TIC); Germany – Mannheim Innovation Panel; Israel - Survey on ICT uses and Cyber Defence in Businesses; Italy - Rilevazione sulle tecnologie dell'informazione e della comunicazione (ICT) nelle imprese; Japan - Japanese National Innovation Survey; Korea - Survey on Business Activities; Portugal - Inquérito à Utilização de Tecnologias da Informação e da Comunicação nas Empresas (IUTICE); Switzerland - KOF Enterprise Panel.

Figure A.4 Share of AI users by number of technologies

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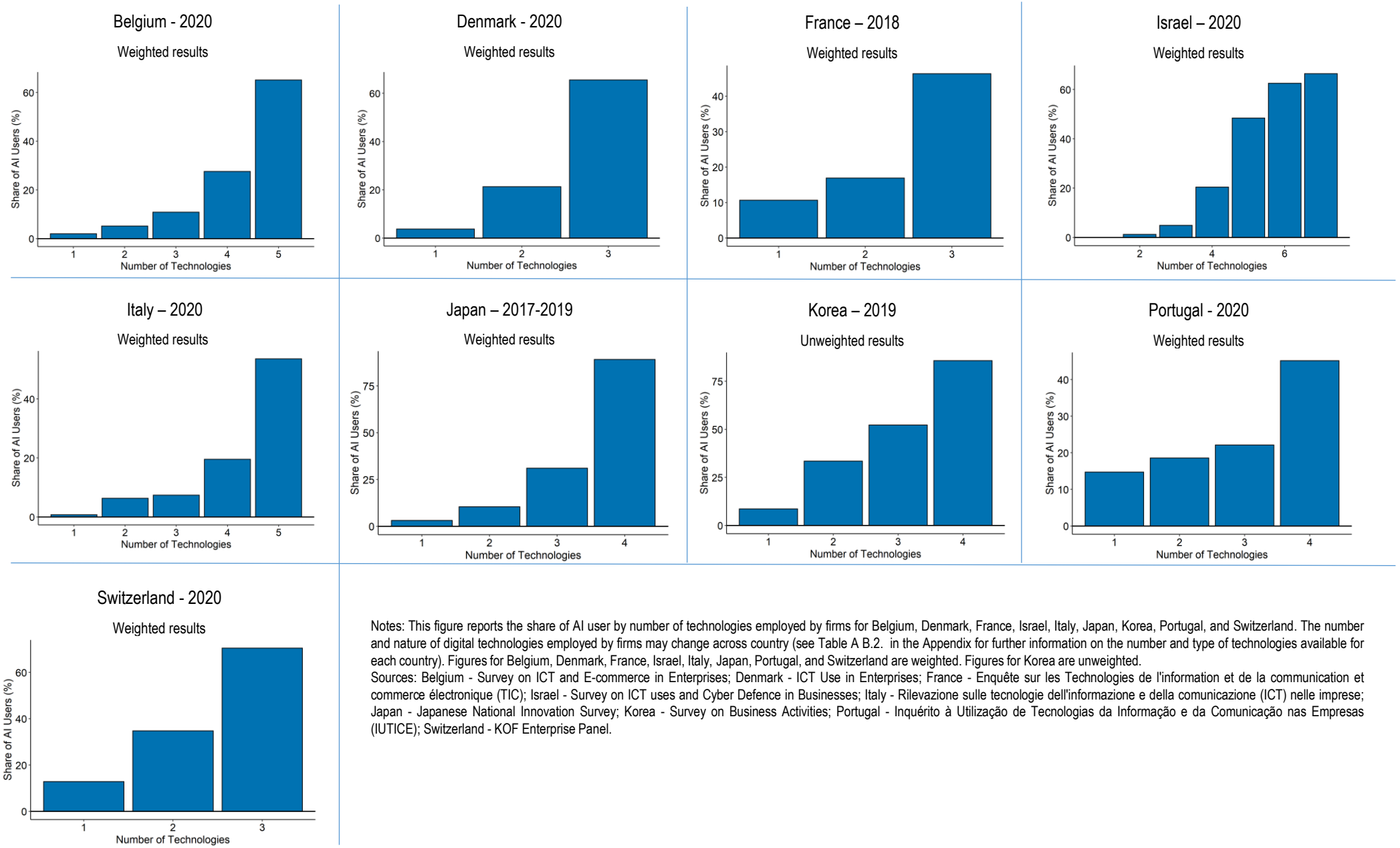

Notes: This figure reports the share of AI user by number of technologies employed by firms for Belgium, Denmark, France, Israel, Italy, Japan, Korea, Portugal, and Switzerland. The number and nature of digital technologies employed by firms may change across country (see Table A B.2. in the Appendix for further information on the number and type of technologies available for each country). Figures for Belgium, Denmark, France, Israel, Italy, Japan, Portugal, and Switzerland are weighted. Figures for Korea are unweighted.

Sources: Belgium - Survey on ICT and E-commerce in Enterprises; Denmark - ICT Use in Enterprises; France - Enquête sur les Technologies de l'information et de la communication et commerce électronique (TIC); Israel - Survey on ICT uses and Cyber Defence in Businesses; Italy - Rilevazione sulle tecnologie dell'informazione e della comunicazione (ICT) nelle imprese; Japan - Japanese National Innovation Survey; Korea - Survey on Business Activities; Portugal - Inquérito à Utilização de Tecnologias da Informação e da Comunicação nas Empresas (IUTICE); Switzerland - KOF Enterprise Panel.

Figure A.5 Share of AI users by productivity class

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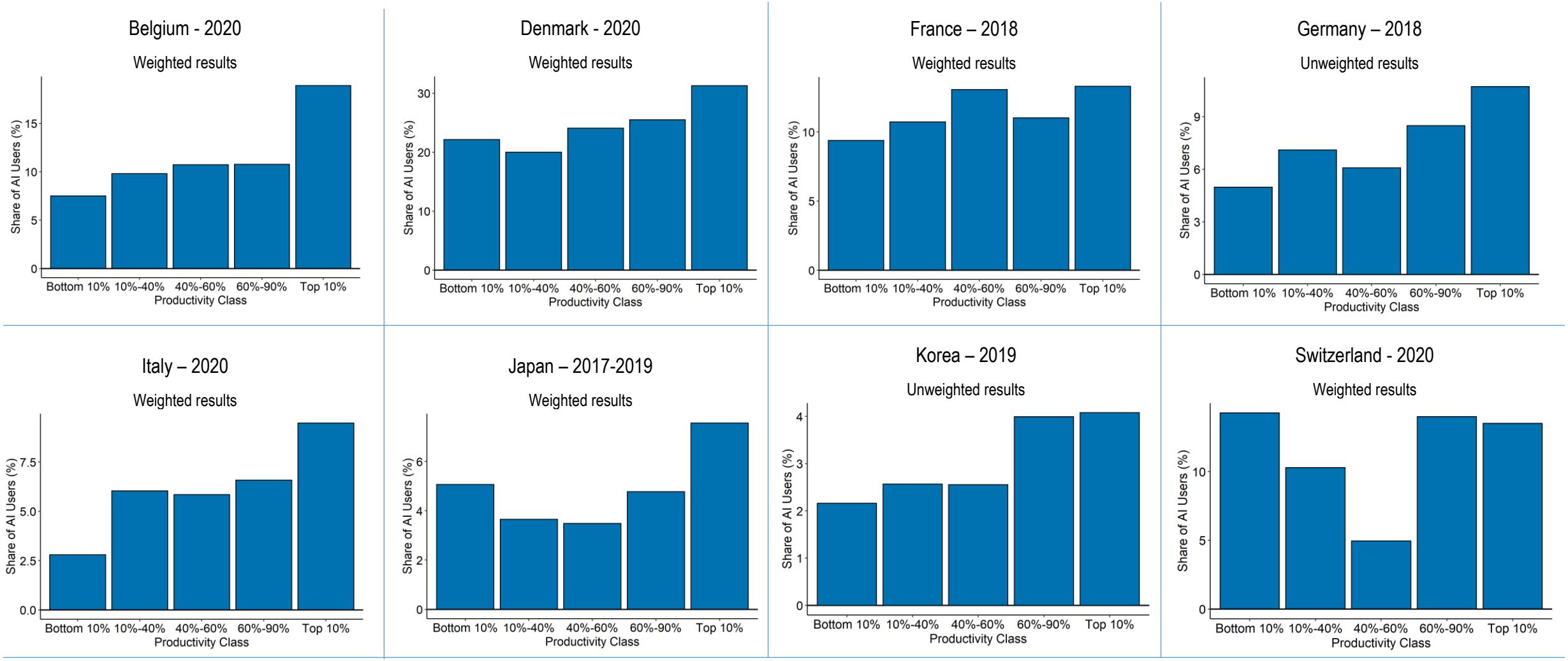

Notes: This figure reports the shares of AI users by productivity class for Belgium, Denmark, France, Germany, Italy, Japan, Korea, and Switzerland. Firms are divided in productivity classes based on quantiles of the productivity distribution. These are computed at the industry SNA A38 level to take into account sector-level differences in productivity levels. The analysis distinguishes six productivity classes: top 10%, between 90% and 60%, between 60% and 40%, between 40% and 10%, and bottom 10% of the productivity distribution. Quantiles are weighted for Belgium, Denmark, France, Italy, Japan, and Switzerland, and are unweighted for Germany and Korea.

Sources: Belgium - Survey on ICT and E-commerce in Enterprises; Denmark - ICT Use in Enterprises; France - Technologies de l'information et de la communication et commerce électronique (TIC); Germany – Mannheim Innovation Panel; Italy - Rilevazione sulle tecnologie dell'informazione e della comunicazione (ICT) nelle imprese; Japan - Japanese National Innovation Survey; Korea - Survey on Business Activities; Switzerland - KOF Enterprise Panel.

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Table A.1 Estimation results for the baseline adoption regressions

	Belgium	Denmark	France	Germany	Israel	Italy	Japan	Korea	Portugal	Switzerland
Size class 20-49	0.0531***	0.0329***	-0.00122	0.0156	0.0218*	0.00887	0.00955	0.00158	-0.00404	0.0365**
	(0.0180)	(0.00651)	(0.0101)	(0.012)	(0.0128)	(0.0109)	(0.0112)	(0.00383)	(0.0222)	(0.0168)
Size class 50-249	0.0829***	0.0778***	0.0223*	0.0199*	0.0147	0.0420***	0.0309***	0.0128***	0.0546***	0.0448**
	(0.0186)	(0.00656)	(0.0118)	(0.0111)	(0.0133)	(0.0109)	(0.00944)	(0.00344)	(0.0211)	(0.0180)
Size class 250+	0.332***	0.244***	0.0953***	0.104***	0.0641***	0.190***	0.151***	0.0496***	0.133***	0.182***
	(0.0270)	(0.0110)	-0.0129	(0.0202)	(0.0153)	(0.0126)	(0.0117)	(0.00411)	(0.0240)	(0.0236)
Age class 6-10	0.0701**	-0.0291***	-0.0402*		0.0119		0.0550**	-0.0166***	-0.0274	-0.0212
	(0.0276)	(0.0106)	(0.0233)		(0.0245)		(0.0233)	(0.00545)	(0.0591)	(0.0551)
Age class 11+	0.0376**	-0.0461***	-0.0526***		-0.0116		0.0621***	-0.0175***	-0.00285	-0.0227
	(0.0172)	(0.00890)	(0.0204)		(0.0160)		(0.0185)	(0.00494)	(0.0536)	(0.0479)
Observations	2,628	15,960	8,981	3,054	1,987	15,557	10,854	38,629	3,772	4,248
R-squared	0.136	0.151	0.032	0.0489	0.244	0.032	0.077	0.065	0.041	0.121
Industry Fixed Eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Eff.	No	Yes	No	No	No	No	No	Yes	No	Yes

Notes: This table reports the main estimation results of the baseline adoption regression for Belgium, Denmark, France, Germany Israel, Italy, Japan, Korea, Portugal, and Switzerland. The baseline adoption regression is a linear probability model that employs the AI use dummy as dependent variable and includes size and age classes as main independent variables. Each regression includes 2-digit sector and, upon availability, year fixed effects. The estimated regressions are weighted for Belgium, Denmark, France, Israel, Italy, Japan, Portugal, and Switzerland, and are unweighted for Germany and Korea. Coefficients for variable "age = missing" are not reported for France, Israel, Japan, Korea, Portugal, and Switzerland. Regression constant is also not reported. Robust standard errors in parenthesis: *** p<0.01, ** p<0.05, * p<0.1.

Sources: AI diffuse elaborations based on: Belgium - Survey on ICT and E-commerce in Enterprises; Denmark - ICT Use in Enterprises; France - Enquête sur les Technologies de l'information et de la communication et commerce électronique (TIC); Germany – Mannheim Innovation Panel; Israel - Survey on ICT uses and Cyber Defence in Businesses; Italy - Rilevazione sulle tecnologie dell'informazione e della comunicazione (ICT) nelle imprese; Japan - Japanese National Innovation Survey; Korea - Survey on Business Activities; Portugal - Inquérito à Utilização de Tecnologias da Informação e da Comunicação nas Empresas (IUTICE); Switzerland - KOF Enterprise Panel.

Table A.2 Estimation results of the extended adoption regressions

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	Belgium	Denmark	France	Germany	Israel	Italy	Japan	Korea	Portugal	Switzerland
Size class 20-49	0.0337*	0.0289***	-0.0132	0.0131	0.0132	0.00656	0.00501	-0.000548	-0.0199	0.0226
	(0.0173)	(0.00815)	(0.0101)	(0.0153)	(0.0134)	(0.0106)	(0.0108)	(0.00373)	(0.0220)	(0.0195)
Size class 50-249	0.0359*	0.0450***	-0.0138	-0.00571	-0.00490	0.0375***	0.0175*	0.00561*	0.0167	0.0286
	(0.0189)	(0.00894)	(0.0130)	(0.0139)	(0.0142)	(0.0109)	(0.00981)	(0.00329)	(0.0228)	(0.0232)
Size class 250+	0.216***	0.169***	0.0242	0.0949***	0.0157	0.181***	0.121***	0.0330***	0.0764***	0.109***
	(0.0293)	(0.0155)	(0.0170)	(0.0260)	(0.0229)	(0.0128)	(0.0131)	(0.00383)	(0.0273)	(0.0320)
Age class 6-10	0.0560**	-0.0190	-0.0412*		0.0103		0.0564**	-0.0150***	-0.0396	-0.108
	(0.0266)	(0.0129)	(0.0230)		(0.0248)		(0.0235)	(0.00527)	(0.0615)	(0.0792)
Age class 11+	0.0259	-0.0428***	-0.0515**		-0.0170		0.0584***	-0.0156***	-0.0162	-0.117*
	(0.0170)	(0.0108)	(0.0200)		(0.0165)		(0.0194)	(0.00477)	(0.0559)	(0.0708)
Ultra-Fast Broad. (>= 100 Mbits/sec)	0.0240*		0.0334**		0.00554	0.00528			0.0129	
	(0.0126)		(0.0144)		(0.0138)	(0.00905)			(0.0251)	
Cloud Adopter		0.0465***			0.0141	0.0319***	0.100***	0.223***		0.0257
		(0.00665)			(0.00922)	(0.00853)	(0.0156)	(0.0107)		(0.0186)
ICT Specialists		0.0986***	0.0390**		0.0530**					0.0780***
		(0.0136)	(0.0152)		(0.0215)					(0.0216)
ICT Training (for other employees)		0.0366**	0.0275**		0.0455					
		(0.0155)	(0.0126)		(0.0403)					
No. of Digital Tech	0.371***		0.0789***						0.156***	
	(0.0380)		(0.0178)						(0.0348)	
Exporter				0.0309**						
				(0.0150)						
Skilled Employees				0.0299						
				(0.0250)						
Training for Employees				0.0218*						
				(0.0118)						
Financially Constrained				-0.0215						
				(0.0327)						
Innovator				0.0450***						
				(0.0102)						
Observations	2,628	11,597	8,981	3,054	1,987	15,554	10,840	38,629	3,733	2,620
R-squared	0.206	0.188	0.043	0.271	0.261	0.036	0.116	0.146	0.057	0.120
Industry Fixed Eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Eff.	No	Yes	No	No	No	No	No	Yes	No	Yes

Notes: This table reports the main estimation results of the extended version of the adoption regression for Belgium, Denmark, France, Germany Israel, Italy, Japan, Korea, Portugal, and Switzerland. The adoption regression is a linear probability model that employs the AI use dummy as dependent variable and includes size and age classes, and other complementary factors as main independent variables. Complementary factors change across countries and mainly include ICT skills (ICT specialists and training), digital infrastructure (use of ultra-fast broadband connection), digital capabilities (cloud computing use and number of other digital technologies). Each regression includes 2-digit sector and, upon availability, year fixed effects. The estimated regressions are weighted for Belgium, Denmark, France, Israel, Italy, Japan, Portugal, and Switzerland, and are unweighted for Germany and Korea. Coefficients for variable "age = missing" are not reported for France, Israel, Japan, Korea, Portugal, and Switzerland. Regression constant is also not reported. Robust standard errors in parenthesis: *** p<0.01, ** p<0.05, * p<0.1.

Sources: AI diffuse elaborations based on: Belgium - Survey on ICT and E-commerce in Enterprises; Denmark - ICT Use in Enterprises; France - Enquête sur les Technologies de l'information et de la communication et commerce électronique (TIC); Germany – Mannheim Innovation Panel; Israel - Survey on ICT uses and Cyber Defence in Businesses; Italy - Rilevazione sulle tecnologie dell'informazione e della comunicazione (ICT) nelle imprese; Japan - Japanese National Innovation Survey; Korea - Survey on Business Activities; Portugal - Inquérito à Utilização de Tecnologias da Informação e da Comunicação nas Empresas (IUTICE); Switzerland - KOF Enterprise Panel.

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Table A.3 Estimation results of the baseline productivity regressions

	Belgium	Denmark	France	Germany	Israel	Italy	Japan	Korea	Switzerland
AI Adoption	0.338***	0.0869***	0.0642**	0.0985*	0.0656	0.146***	0.0736	0.176***	0.0383
	(0.0980)	(0.0268)	(0.0301)	(0.0506)	(0.219)	(0.0491)	(0.128)	(0.0309)	(0.0421)
Size class 20-49	0.0966	0.0935***	0.207***	0.102***	0.0923	0.145***	-0.0171	-0.213***	-0.0369
	(0.0667)	(0.0161)	(0.0224)	(0.0374)	(0.0748)	(0.0275)	(0.0550)	(0.0432)	(0.0337)
Size class 50-249	0.0158	0.138***	0.300***	0.216***	0.152**	0.286***	0.110**	-0.395***	0.0674*
	(0.0721)	(0.0157)	(0.0279)	(0.0365)	(0.0763)	(0.0265)	(0.0454)	(0.0401)	(0.0373)
Size class 250+	0.153*	0.216***	0.365***	0.441***	-0.0154	0.311***	0.432***	-0.262***	0.155**
	(0.0924)	(0.0216)	(0.0349)	(0.0481)	(0.0892)	(0.0300)	(0.0471)	(0.0413)	(0.0612)
Age class 6-10	0.209*	0.0982***	0.103*		0.338***		0.000643	-0.0235	0.179
	(0.119)	(0.0267)	(0.0545)		(0.121)		(0.166)	(0.0295)	(0.143)
Age class 11+	0.0327	0.169***	0.184***		0.714***		0.231*	0.0482*	-0.00322
	(0.0943)	(0.0225)	(0.0495)		(0.103)		(0.137)	(0.0256)	(0.0902)
Observations	2,599	15,960	8,968	3,054	2,019	15,557	10,637	38,608	3,934
R-squared	0.369	0.401	0.375	0.271	0.307	0.485	0.395	0.438	0.478
Industry Fixed Eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Eff.	No	Yes	No	No	No	No	No	Yes	Yes

Notes: This table reports the main estimation results of the baseline productivity regression for Belgium, Denmark, France, Germany, Israel, Italy, Japan, Korea, and Switzerland. The baseline productivity regression is an ordinary least square model that includes (log) labour productivity as dependent variable and AI use, size, and age classes as main independent variables. Each regression also controls for sector and, upon availability, year fixed effects. The estimated regressions include 2-digit sectoral fixed effects for Belgium, Denmark, France, Germany, Italy, Japan, Korea, and Switzerland, and SNA 38 fixed effects for Israel. The estimated regressions are weighted for Belgium, Denmark, France, Israel, Italy, Japan, and Switzerland, and are unweighted for Germany and Korea. Coefficients for variable "age = missing" are not reported for France, Israel, Japan, Korea, and Switzerland. Regression constant is also not reported. Robust standard errors in parenthesis: *** p<0.01, ** p<0.05, * p<0.1.

Sources: AI diffuse elaborations based on: Belgium - Survey on ICT and E-commerce in Enterprises; Denmark - ICT Use in Enterprises; France - Enquête sur les Technologies de l'information et de la communication et commerce électronique (TIC); Germany – Mannheim Innovation Panel; Israel - Survey on ICT uses and Cyber Defence in Businesses; Italy - Rilevazione sulle tecnologie dell'informazione e della comunicazione (ICT) nelle imprese; Japan - Japanese National Innovation Survey; Korea - Survey on Business Activities; Switzerland - KOF Enterprise Panel.

Table A.4 Estimation from the productivity regressions including the interaction between AI and size

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	Belgium	Denmark	France	Germany	Israel	Italy	Japan	Korea	Switzerland
AI Adoption	0.389*	-0.0438	0.0898**	0.0364	-0.422	0.117	-0.108	-0.584	-0.000291
	(0.230)	(0.0601)	(0.0453)	(0.0998)	(0.644)	(0.0775)	(0.157)	(0.413)	(0.0982)
Size class 20-49	0.109	0.0772***	0.218***	0.106***	0.0893	0.143***	-0.00957	-0.204***	-0.0309
	(0.0684)	(0.0163)	(0.0236)	(0.0391)	(0.0740)	(0.0283)	(0.0553)	(0.0433)	(0.0355)
Size class 50-249	0.0217	0.118***	0.300***	0.214***	0.128*	0.284***	0.0945**	-0.402***	0.0494
	(0.0759)	(0.0156)	(0.0296)	(0.0376)	(0.0759)	(0.0270)	(0.0464)	(0.0403)	(0.0390)
Size class 250+	0.0870	0.174***	0.338***	0.415***	-0.111	0.250***	0.353***	-0.281***	0.120
	(0.0953)	(0.0217)	(0.0404)	(0.051)	(0.0891)	(0.0314)	(0.0461)	(0.0415)	(0.0728)
AI × Size class 20-49	-0.124	0.194***	-0.103	-0.0466	0.378	0.0278	-0.119	-0.136	-0.0394
	(0.274)	(0.0740)	(0.0717)	(0.130)	(0.720)	(0.121)	(0.355)	(0.444)	(0.112)
AI × Size class 50-249	-0.0685	0.194***	-0.00567	0.0571	0.806	0.0314	0.375*	0.695*	0.206
	(0.251)	(0.0668)	(0.0773)	(0.147)	(0.694)	(0.109)	(0.196)	(0.415)	(0.126)
AI × Size class 250+	0.115	0.232***	0.120*	0.213	1.306**	0.272***	0.593***	0.939**	0.176
	(0.252)	(0.0702)	(0.0713)	(0.133)	(0.658)	(0.0910)	(0.166)	(0.416)	(0.134)
Age class 6-10	0.209*	0.0966***	0.104*		0.340***		0.00488	-0.0271	0.177
	(0.120)	(0.0266)	(0.0545)		(0.120)		(0.166)	(0.0294)	(0.142)
Age class 11+	0.0321	0.166***	0.184***		0.711***		0.238*	0.0446*	-0.0103
	(0.0948)	(0.0224)	(0.0494)		(0.103)		(0.136)	(0.0255)	(0.0899)
Observations	2,599	15,960	8,968	3,054	2,019	15,557	10,637	38,608	3,934
R-squared	0.370	0.402	0.375	0.271	0.310	0.486	0.397	0.439	0.480
Industry Fixed Eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Eff.	No	Yes	No	No	No	No	No	Yes	Yes

Notes: This table reports the main estimation results of the productivity regression encompassing the AI-size interaction terms for Belgium, Denmark, France, Germany Israel, Italy, Japan, Korea, and Switzerland. This productivity regression is an ordinary least squares model that includes (log) labour productivity as dependent variable and AI use, size and age classes and the interaction terms between AI and size classes as main independent variables. Each regression controls for 2-digit sector and, upon availability, year fixed effects. The estimated regressions include 2-digit sectoral fixed effects for Belgium, Denmark, France, Germany, Italy, Japan, Korea, and Switzerland, and SNA 38 fixed effects for Israel. The estimated regressions are weighted for Belgium, Denmark, France, Israel, Italy, Japan, and Switzerland, and are unweighted for Germany and Korea. All Coefficients for variable "age = missing" are not reported for France, Israel, Japan, Korea, and Switzerland. Regression constant is also not reported. Robust standard errors in parenthesis: *** p<0.01, ** p<0.05, * p<0.1.

Sources: AI diffuse elaborations based on: Belgium - Survey on ICT and E-commerce in Enterprises; Denmark - ICT Use in Enterprises; France - Enquête sur les Technologies de l'information et de la communication et commerce électronique (TIC); Germany – Mannheim Innovation Panel; Israel - Survey on ICT uses and Cyber Defence in Businesses; Italy - Rilevazione sulle tecnologie dell'informazione e della comunicazione (ICT) nelle imprese; Japan - Japanese National Innovation Survey; Korea - Survey on Business Activities; Switzerland - KOF Enterprise Panel.

Table A.5 Estimation of the extended productivity regressions including the complementary factors

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	Belgium	Denmark	France	Germany	Israel	Italy	Japan	Korea	Switzerland
AI Adoption	0.262**	0.0588**	0.0272	0.0205	-0.0590	0.0748	-0.0826	0.0162	-0.0248
	(0.102)	(0.0287)	(0.0298)	(0.0515)	(0.227)	(0.0482)	(0.130)	(0.0348)	(0.0448)
Size class 20-49	0.0773	0.0828***	0.167***	0.0255	0.0148	0.110***	-0.0233	-0.217***	-0.0454
	(0.0666)	(0.0187)	(0.0223)	(0.0477)	(0.0749)	(0.0282)	(0.0550)	(0.0432)	(0.0359)
Size class 50-249	-0.0219	0.0922***	0.188***	0.0953**	-0.00240	0.214***	0.0859*	-0.402***	0.00525
	(0.0736)	(0.0190)	(0.0292)	(0.0479)	(0.0792)	(0.0276)	(0.0458)	(0.0401)	(0.0419)
Size class 250+	0.0668	0.112***	0.150***	0.308***	-0.301***	0.175***	0.380***	-0.282***	0.0223
	(0.0982)	(0.0278)	(0.0413)	(0.0580)	(0.102)	(0.0332)	(0.0493)	(0.0413)	(0.0719)
Age class 6-10	0.198*	0.0935***	0.0972*		0.326***		-0.000842	-0.0202	0.0837
	(0.118)	(0.0314)	(0.0543)		(0.122)		(0.165)	(0.0294)	(0.160)
Age class 11+	0.0254	0.165***	0.183***		0.658***		0.223	0.0508**	-0.0620
	(0.0935)	(0.0264)	(0.0494)		(0.106)		(0.137)	(0.0256)	(0.0935)
Cloud Adopter					0.233***				
					(0.0601)				
Ultra-Fast Broad. (>= 100 Mbits/sec)	0.137**		0.200***		0.218***				
	(0.0554)		(0.0363)		(0.0734)				
No. of Digital Tech	0.279**		0.282***			0.474***	0.414***	0.525***	0.306***
	(0.123)		(0.0369)			(0.0515)	(0.0958)	(0.0469)	(0.0792)
ICT specialists		0.0604**	0.0699**		0.241**				0.0888**
		(0.0274)	(0.0328)		(0.113)				(0.0378)
ICT Training (for other employees)		0.0924***	0.0662**		0.0546				
		(0.0284)	(0.0276)		(0.172)				
Training for Employees				0.0777**					
				(0.0321)					
Skilled employees				0.169***					
				(0.0603)					
Financially constrained				-0.207***					
				(0.0760)					
Innovator				0.0750*					
				(0.0417)					
Exporter				0.319***					
				(0.0417)					
Observations	2,599	11,597	8,968	1,991	2,019	15,557	10,637	38,608	3,535
R-squared	0.374	0.414	0.391	0.317	0.331	0.497	0.400	0.439	0.483
Industry Fixed Eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Eff.	No	Yes	No	No	No	No	No	Yes	Yes

Notes: This table reports the main estimation results of the extended version of the productivity regression for Belgium, Denmark, France, Germany Israel, Italy, Japan, Korea, and Switzerland. This productivity regression is an ordinary least squares model that includes (log) labour productivity as dependent variable and AI use, size and age classes and complementary assets as main independent variables. Each regression controls for 2-digit sector and, upon availability, year fixed effects. The estimated regressions include 2-digit sectoral fixed effects for Belgium, Denmark, France, Germany, Italy, Japan, Korea, and Switzerland, and SNA 38 fixed effects for Israel. Complementary assets change on a country basis and mainly include ICT skills (ICT specialists and training), digital infrastructure (use of ultra-fast broadband connection), digital capabilities (cloud computing use and number of other digital technologies). The estimated regressions are weighted for Belgium, Denmark, France, Israel, Italy, Japan, and Switzerland, and are unweighted for Germany and Korea. Coefficients for variable "age = missing" are not reported for France, Israel, Japan, Korea, and Switzerland. Regression constant is also not reported. Robust standard errors in parenthesis: *** p<0.01, ** p<0.05, * p<0.1.

Sources: AI diffuse elaborations based on: Belgium - Survey on ICT and E-commerce in Enterprises; Denmark - ICT Use in Enterprises; France - Enquête sur les Technologies de l'information et de la communication et commerce électronique (TIC); Germany – Mannheim Innovation Panel; Israel - Survey on ICT uses and Cyber Defence in Businesses; Italy - Rilevazione sulle tecnologie dell'informazione e della comunicazione (ICT) nelle imprese; Japan - Japanese National Innovation Survey; Korea - Survey on Business Activities; Switzerland - KOF Enterprise Panel.

Table A.6 Metadata information: variables

Country	BELGIUM	DENMARK	FRANCE	GERMANY	ISRAEL	ITALY	JAPAN	KOREA	PORTUGAL	SWITZERLAND
Survey name	Survey ICT and e-commerce in enterprises	ICT Use in Enterprises	Technologies de l'information et de la communication et commerce électronique (TIC)	Mannheim Innovation Panel	Survey on ICT uses and cyber defense in businesses	Rilevazione sulle tecnologie dell'informazione e della comunicazione (ICT) nelle imprese	Japanese National Innovation Survey 2020	Survey of Business activities	Inquérito à Utilização de Tecnologias da Informação e da Comunicação nas Empresas (IUTICE)	KOF Enterprise Panel, years 2018 2020
Survey year (DOI)	2021	2017, 2018, 2019, 2021	2019 (https://doi.org/10.34724/CASD.49.3251.V1)	2019	2020**	2021	2020	2018, 2019, 2020	2021	2019, 2020, 2021
AI use year*	2020	2016, 2017, 2018, 2020	2018	2018	2020**	2020	2017 to 2019	2017, 2018, 2019	2020	2018, 2019, 2020
Productivity year	2020	2016, 2017, 2018, 2020	2018	2018	2019	2020***	2019	2017, 2018, 2019	2020 (preliminary)	2018, 2019, 2020
Productivity measure	Turnover/employment	Turnover/employment	Turnover/employment	Turnover/employment	Turnover/employment	Turnover/employment	Turnover/employment	Turnover/employment	Turnover/employment	Turnover/employ
Firm age	YES	YES	YES	NO	YES	NO	YES	YES	YES	YES
Cloud tech.	YES	YES****	NO	NO	YES	YES	YES	YES	YES	YES
Ultra-fast Broadband	YES	NO	YES	NO	YES	YES	NO	NO	YES	NO
ICT specialist	NO	YES	YES	YES	YES	NO	NO	NO	NO	YES
ICT training (for other employees)*****	NO	YES	YES	NO	YES	NO	NO	NO	NO	NO
Other variables	-	-	-	financial constraints, training for employees, export, process innovations	-	-	-	-	-	-
Number of other tech. (last year)	6	4	3	0	8	5	4	5	4	3*****
Other technologies (last year)	cloud, CRM, e-commerce, ERP, IoT, ML	big data, cloud, ERP, IoT	e-commerce, ERP, CRM	-	3-D printing, robots, IoT, ERP, CRM, e-commerce, big data, cloud	IoT, cloud, CRM, e-commerce, ERP	3-D printing, IoT, big data, cloud	big data, cloud, IoT, robots, 3-D printing	cloud, CRM, ERP, IoT	big data, e-commerce, robots

Notes: *In most countries, surveys have been administered in the beginning of year *t*. Consequently, AI use can be assumed to largely reflect patterns in year *t-1*. **For Israel, the survey was administered between July 2020 and March 2021. ***For Italy, the productivity variable relies on 2019 data in case of missing employment in 2020. ****For Denmark, the cloud variable is not available in 2018. ***** For Israel, ICT training refers to firms providing any type of training to develop ICT related skills of the persons employed. For France and Denmark, ICT training refers to firms providing ICT training for other (non-ICT) employees. ******For the years 2019 and 2020, Switzerland has the following 8 technological variables available: 3-D printing, robots, IoT, ERP, CRM, e-commerce, big data, cloud.

Table A.7 Metadata information: summary and regression details

Country	BELGIUM	DENMARK	FRANCE	GERMANY	ISRAEL	ITALY	JAPAN	KOREA	PORTUGAL	SWITZERLAND
Weighted results	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES
Deflated productivity	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Surveyed units	enterprises with 2 or more employees*	enterprises with at least 10 persons employed	enterprises with at least 10 persons employed	enterprises with at least 10 persons employed-	enterprises with at least 10 persons employed	enterprises with 10 or more persons employed	enterprises with 10 or more persons employed	Active corporations with at least 50 full-time employees and 300 million KRW or more capital stock.** Survey unit: Establishment	enterprises with 10 or more persons employed	enterprises with 5 or more employees*
Sectors included	NACE Rev. 2: C, D, E, F, G, H, I, J, L, M, N; 95.1	NACE Rev. 2: C, D, E, F, G, H, I, J, L, M, N; 95.1	NACE Rev. 2: C, D, E, F, G, H, I, J, L, N; 69-74; 95	NACE Rev. 2: 5-33, 35-39, 46, 49-53, 58-66, 69, 70.2, 71-74, 78-82	ISIC Rev. 4: B, C, D, E, F, G, H, I, J, M, L, N	NACE Rev. 2: C, D, E, F, G, H, I, J, L, M, N; 95.1	ISIC Rev. 4: A, B, C, D, E, F, G, H, I, J, K, L, M, N (sectors reported based on conversion from JSIC)	2-digit KSIC (Korean Standard Industrial Classification) converted to ISIC Rev. 4. All Industries.	NACE Rev. 2: C, D, E, F, G, H, I, J, L, M, N; 95.1	NACE Rev. 2: 10-27, 261-264, 2651, 266-268, 33, 325, 2652, 29-31, 321-324, 329, 35-39, 41-43, 45-47, 49-53, 55-56, 58-66, 68-74, 77, 79-82, 95-96

Notes: *micro firms (<10 employees) are excluded when computing summary statistics and regressions. **For Korea, the surveys also target enterprises in the 'Wholesale and Retail Trade" sectors, service industries and other service industries, with capital stock of 1 billion won or more even though they have 49 full-time employees or less.

Table A.8 AI definitions across surveys and AI use questions

Country	Survey name	AI definition	AI use: survey question and options
BELGIUM[a]	Survey ICT and e-commerce in enterprises	Artificial intelligence refers to systems that use technologies such as: text mining, computer vision, speech recognition, natural language generation, machine learning, deep learning to gather and/or use data to predict, recommend or decide, with varying levels of autonomy, the best action to achieve specific goals. Artificial intelligence systems can be purely software based, e.g.: – chatbots and business virtual assistants based on natural language processing; – face recognition systems based on computer vision or speech recognition systems; – machine translation software; – data analysis based on machine learning, etc.; or embedded in devices, e.g.: – autonomous robots for warehouse automation or production assembly works; – autonomous drones for production surveillance or parcel handling, etc.	Does your enterprise use any of the following Artificial Intelligence technologies? AI use is related to the selection of any of the following options: [a]a) Technologies performing analysis of written language (text mining), b) Technologies converting spoken language into machine-readable format (speech recognition), c) Technologies generating written or spoken language (natural language generation), d) Technologies identifying objects or persons based on images (image recognition, image processing), e) Machine learning (e.g. deep learning) for data analysis, f) Technologies automating different workflows or assisting in decision making (Artificial Intelligence based software robotic process automation, g) Technologies enabling physical movement of machines via autonomous decisions based on observation of surroundings (autonomous robots, selfdriving vehicles, autonomous drones)[a].
DENMARK	ICT Use in Enterprises[a]	Artificial intelligence refers to systems that use technologies such as: text mining, computer vision, speech recognition, natural language generation, machine learning, deep learning to gather and/or use data to predict, recommend or decide, with varying levels of autonomy, the best action to achieve specific goals. Artificial intelligence systems can be purely software based, e.g.: – chatbots and business virtual assistants based on natural language processing; – face recognition systems based on computer vision or speech recognition systems; – machine translation software; – data analysis based on machine learning, etc.; or embedded in devices, e.g.: – autonomous robots for warehouse automation or production assembly works; – autonomous drones for production surveillance or parcel handling, etc.***	Does your enterprise use any of the following Artificial Intelligence technologies? AI use is related to the selection of any of the following options: [a]a) Technologies performing analysis of written language (text mining), b) Technologies converting spoken language into machine-readable format (speech recognition), c) Technologies generating written or spoken language (natural language generation), d) Technologies identifying objects or persons based on images (image recognition, image processing), e) Machine learning (e.g. deep learning) for data analysis, f) Technologies automating different workflows or assisting in decision making (Artificial Intelligence based software robotic process automation, g) Technologies enabling physical movement of machines via autonomous decisions based on observation of surroundings (autonomous robots, selfdriving vehicles, autonomous drones)[a].***
FRANCE	Technologies de l'information et de la communication et commerce électronique (TIC)	*L'intelligence artificielle désigne, sous un terme unique, l'ensemble des technologies visant à réaliser par l'informatique des tâches cognitives traditionnellement effectuées par l'humain : reconnaissance vocale, biométrie, reconnaissance d'images, aide à la décision, etc.*	*En 2018, votre entreprise a-t-elle eu recours à des logiciels et/ou des équipements intégrant des technologies d'intelligence artificielle?* AI use is related to the selection of any of the following options: *1) Ces logiciels et/ou équipements ont été développés principalement par les employés de votre entreprise (y compris ceux provenant de la maison-mère ou de filiales). 2) Ces logiciels et/ou équipements ont été développés principalement par un prestataire externe, pour répondre spécifiquement aux besoins de votre entreprise. 3) Ces logiciels et/ou équipements font partie d'offres "sur étagère" de fournisseurs.*
GERMANY	Mannheim Innovation Panel (MIP)	Artificial Intelligence (AI): a method of information processing that allows computers to autonomously solve problems.	Does your enterprise use Artificial Intelligence methods? Yes/No option
ISRAEL	Survey on ICT uses and cyber defense in businesses	Artificial Intelligence is a multidisciplinary field devoted to making machines intelligent; intelligence being the quality that enables an entity to function appropriately in its environment. Today, most applications in the field are based on the ability of machines and systems to interpret data, to learn and derive insights from said data, and to use these insights to perform tasks and achieve goals all in an adaptive process.	Does your enterprise use AI technologies and/or services? Yes/No option
ITALY[a]	Rilevazione sulle tecnologie dell'informazione e della comunicazione (ICT) nelle imprese	Artificial intelligence refers to systems that use technologies such as: text mining, computer vision, speech recognition, natural language generation, machine learning, deep learning to gather and/or use data to predict, recommend or decide, with varying levels of autonomy, the best action to achieve specific goals. Artificial intelligence systems can be purely software based, e.g.: – chatbots and business virtual assistants based on natural language processing; – face recognition systems based on computer vision or speech recognition systems; – machine translation software; – data analysis based on machine learning, etc.; or embedded in devices, e.g.: – autonomous robots for warehouse automation or production assembly works; – autonomous drones for production surveillance or parcel handling, etc.	Does your enterprise use any of the following Artificial Intelligence technologies? AI use is related to the selection of any of the following options: [a]a) Technologies performing analysis of written language (text mining), b) Technologies converting spoken language into machine-readable format (speech recognition), c) Technologies generating written or spoken language (natural language generation), d) Technologies identifying objects or persons based on images (image recognition, image processing), e) Machine learning (e.g. deep learning) for data analysis, f) Technologies automating different workflows or assisting in decision making (Artificial Intelligence based software robotic process automation, g) Technologies enabling physical movement of machines via autonomous decisions based on observation of surroundings (autonomous robots, selfdriving vehicles, autonomous drones)[a].
JAPAN	Japanese National Innovation Survey 2020	Machine learning (AI) is a technology or method that enables a computer to acquire knowledge from experience (data) and automatically perform tasks such as prediction, classification, clustering, and grouping. Machine learning can be broadly divided into "supervised learning" in which correct answer data (a collection of pairs of inputs and outputs (correct answers)) is given, and "unsupervised learning" in which case data (a mere collection of input cases) is given. Machine learning also includes such as "reinforcement learning," which gives clues for learning with rewards (scores) instead of correct answer data. Machine learning can be considered as a field of artificial intelligence (AI).	Section "Usage of digitalisation (during the three years 2017 to 2019)" Please tick (✓) all boxes □ where they are applicable as the purpose of usage in each of the digitalisation [a] to [e]. However, if there is nothing applicable, please tick the box "Not used" only. AI use is related to the selection of Option [d] "Machine learning (AI)", with any of the following purposes of usage: "Improving existing goods or services", "Introducing new goods or services", "Process automation or cost reduction", "Data analysis and collection, or decision support", "Others".
KOREA	Survey of Business activities	AI is a technology that mimics humans by learning, reasoning, perceiving, and understanding the natural language based on the computer programs.	Do you utilize AI in your business? Yes/No option
PORTUGAL[a]	Inquérito à Utilização de Tecnologias da Informação e da Comunicação nas Empresas (IUTICE)	Artificial intelligence refers to systems that use technologies such as: text mining, computer vision, speech recognition, natural language generation, machine learning, deep learning to gather and/or use data to predict, recommend or decide, with varying levels of autonomy, the best action to achieve specific goals. Artificial intelligence systems can be purely software based, e.g.: – chatbots and business virtual assistants based on natural language processing; – face recognition systems based on computer vision or speech recognition systems; – machine translation software; – data analysis based on machine learning, etc.; or embedded in devices, e.g.: – autonomous robots for warehouse automation or production assembly works; – autonomous drones for production surveillance or parcel handling, etc.	Does your enterprise use any of the following Artificial Intelligence technologies? Options are: [a]a) Technologies performing analysis of written language (text mining), b) Technologies converting spoken language into machine-readable format (speech recognition), c) Technologies generating written or spoken language (natural language generation), d) Technologies identifying objects or persons based on images (image recognition, image processing), e) Machine learning (e.g. deep learning) for data analysis, f) Technologies automating different workflows or assisting in decision making (Artificial Intelligence based software robotic process automation, g) Technologies enabling physical movement of machines via autonomous decisions based on observation of surroundings (autonomous robots, selfdriving vehicles, autonomous drones)[a].
SWITZERLAND	KOF Enterprise Panel, years 2018-2019[a]**	*L'intelligence artificielle (IA) se définit comme la capacité des machines et systèmes à acquérir et appliquer des connaissances et à se comporter de manière intelligente. Cette IA ou ces technologies basées sur le cognitif aident les ordinateurs et les humains à interagir, comprendre et apprendre afin qu'ils puissent accomplir une multitude de*	*Votre entreprise utilise-t-elle des systèmes basés sur l'intelligence artificielle?*[a]** Oui/Non option